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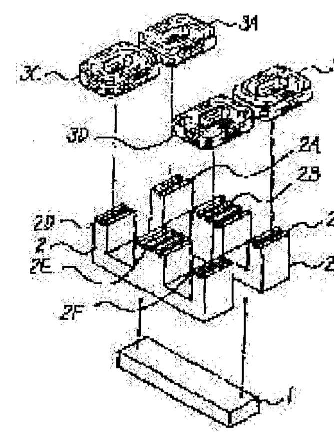
(54) CORE STRUCTURE FOR LINEAR PULSE MOTOR

(57)Abstract:
PURPOSE: To eliminate pitching and yawing of mover, caused by positional difference between excited pole tooth groups upon inversion of current flow through a driving coil for the purpose of driving a linear pulse motor, by interposing one more pole tooth group between the pole tooth groups to be excited and specifying the areal ratio between them.
CONSTITUTION: Areal ratios, i.e., R×S:Q×S:R×S, between pole tooth groups 2A, 2B, 2C and 2D, 2E, 2F is set at 1:2:1. When current is fed to a driving coil and flux of the pole tooth groups 2A, 2C and 2D, 2F is enhanced, cross point of diagonals of a rectangle defined by the centers of the pole tooth groups 2A, 2C, 2D, 2F is the center of attraction. When the flux of the pole tooth groups 2B, 2E is enhanced, the center of the pole tooth groups 2B, 2E is the center of attraction and when the flux of the pole tooth groups 2A, 2C, 2E or 2D, 2F, 2B is enhanced, attraction force of the entire pole teeth functions at the central position. Consequently, forces causing pitching and yawing of a mover are cancelled resulting in a stabilized operation.



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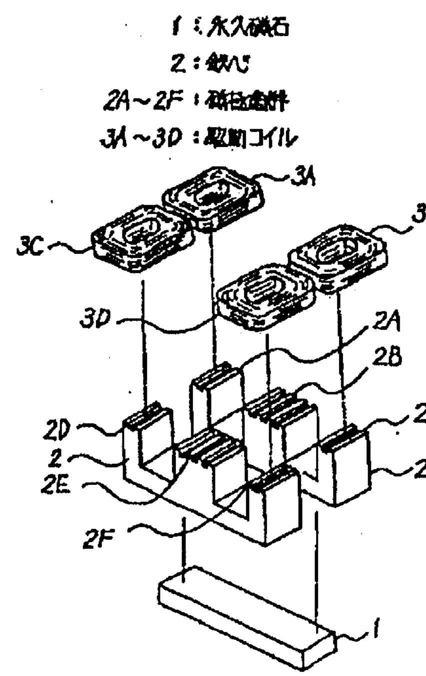
(54)【発明の名称】　リニアパルスモータの鉄心構造

(57)【要約】

【構成】永久磁石１と、永久磁石１をはさみ込んだ２つの鉄心２のそれぞれの端部に設けられた第１および第２の磁極歯群２Ａ，２Ｃおよび２Ｄ，２Ｆと、第１および第２の磁極歯群の磁極にそれぞれ捲回された駆動コイル３Ａ，３Ｂおよび３Ｃ，３Ｄとを有するリニアパルスモータの鉄心構造であって、第１の磁極歯群と第２の磁極歯群との間に凸部を形成した第３の磁極歯群２Ｂ，２Ｅを設け第１の磁極歯群と第３の磁極歯群と第２の磁極歯群とのそれぞれの先端部の面積比をほぼ１対２対１にしている。

【効果】リニアパルスモータを駆動するために駆動コイルに流れる電流を反転させた時に、励磁された磁極歯群の位置の違いにより発生する可動子のピッチング及びヨーイングを無くし、常に安定した動作を確保できる。



【特許請求の範囲】

【請求項1】　永久磁石と、前記永久磁石をはさみ込んだ2つの鉄心のそれぞれの端部に設けられた第1および第2の磁極歯群と、前記第1および第2の磁極歯群の磁極にそれぞれ捲回された駆動コイルとを有するリニアパルスモータの鉄心構造において、前記第1の磁極歯群と第2の磁極歯群との間に凸部を形成した第3の磁極歯群を設け前記第1の磁極歯群と前記第3の磁極歯群と前記第2の磁極歯群とのそれぞれの先端部の面積比をほぼ1対2対1にしたことを特徴とするリニアパルスモータの鉄心構造。

【請求項2】　前記第1，第2および第3の磁極歯群を薄板にエッチングにより一体形成した磁極歯板を磁極歯の施されていない3個の凸型部を有する鉄心の前記凸型部上面に密着させ、樹脂により一体に成形することを特徴とする請求項1記載のリニアパルスモータの鉄心構造。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は磁気ディスク装置のヘッド駆動に使用されるリニアパルスモータの鉄心構造に関し、特に1次鉄心の構造を改良したリニアパルスモータの鉄心構造に関する。

【0002】

【従来の技術】従来のリニアパルスモータの鉄心構造は図4の展開図および図5（a），（b）の組み立て状態を示す側面図，平面図に示すように、永久磁石1をはさみ込んだ鉄心12，14上に、それぞれ均等の面積を有した磁極歯群12A，12B，12C，12Dを有しており、磁極歯群の歯ピッチをPとすると、可動方向の距離で磁極歯群12Bの位置は、磁極歯群12Aに対してL＝（n＋（1／2））P（nは整数）離れた位置であり、磁極歯群12Cは磁極歯群12Aに対してM＝（n＋（1／4））P離れ、同じく可動方向の距離で磁極歯群12Dは磁極歯群12Aに対してN＝（n＋（3／4））P離れた位置に配置されている。ここで磁極歯群12A，12Bを励磁する駆動コイル13A，13Bは、磁極歯群12A（又は12B）を通る永久磁石1の磁束を駆動コイル13A（又は13B）の磁束により強めると同時に、磁極歯群12B（又は12A）を通る永久磁石1の磁束を駆動コイル13B（又は13A）の磁束により相殺する作用をするように接続されている。同様に磁極歯群12C，12Dを励磁する駆動コイル13C，13Dは、磁極歯群12Cを通る永久磁石1の磁束を駆動コイル13Cの磁束により強めると同時に、磁極歯群12Dを通る永久磁石1の磁束を駆動コイル13Dの磁束により相殺する作用をするように、もしくは前述のように逆の作用をするように接続されている。すなわち、図5（a）の固定子10の駆動コイル13A，13Bと駆動コイル13C，13Dとに流す電流の方向を交互に反転することにより、可動子15がP／4づつ移動する励磁ができる磁極歯群配列になっていた。

【0003】

【発明が解決しようとする課題】この従来のリニアパルスモータの磁極歯群配列は、磁極歯群12Aおよび12Cの磁束を強めた場合に、磁極歯群12A，12Cに吸着力が働き、磁極歯群12B，12Dの磁束を強めた場合に、磁極歯群12B，12Dに吸着力が働くので、可動子は移動方向に対してピッチングを発生する。また、磁極歯群12Aと12D又は、磁極歯群12Bと12Cの磁束を強めた場合には、磁束を強めた磁極歯群がそれぞれ対角に位置するので、可動子は移動方向に対してヨーイングを発生する欠点がある。

【0004】従って可動子はピッチングとヨーイングを交互に繰り返しながらP／4づつ移動するために、ヘッド駆動用として使用する場合に、停止精度を悪化させる欠点もあった。

【0005】

【課題を解決するための手段】本発明のリニアパルスモータの鉄心構造は、永久磁石と、前記永久磁石をはさみ込んだ2つの鉄心のそれぞれの端部に設けられた第1および第2の磁極歯群と、前記第1および第2の磁極歯群の磁極にそれぞれ捲回された駆動コイルとを有するリニアパルスモータの鉄心構造において、前記第1の磁極歯群と第2の磁極歯群との間に凸部を形成した第3の磁極歯群を設け前記第1の磁極歯群と前記第3の磁極歯群と前記第2の磁極歯群とのそれぞれの先端部の面積比をほぼ1対2対1にしている。

【0006】

【実施例】次に本発明について図面を参照して説明する。図1は本発明の一実施例の一次鉄心を成形樹脂で固めた完成品の外観を示す斜視図、図2は本発明の第1の実施例の成形樹脂を除いた構成部品を示す展開図である。

【0007】図1の実施例は、成形樹脂4の表面に磁極歯群2A，2B，2C，および磁極歯群2D，2E，2Fの上面部がのぞいており、それぞれ可動方向に平行に配列されている。ここで可動方向の距離で磁極歯群2Aと2Bとの間隔L1および磁極歯群2Bと2Cとの間隔L1は等しく、磁極歯個々のピッチをPとすると、L1＝（n＋（1／2））Pである（nは整数）。同じように磁極歯群2Dと2Eとの間隔L2および磁極歯群2Eと2Fとの間隔L2も等しく、L2＝（n＋（2））Pである。また、可動方向の距離で磁極歯群2Aと2Dの間隔M1、2Bと2Eの間隔M2、2Cと2Fの間隔M3は等しく、P／4だけずれている。また磁極歯群2A，2D，2C，2Fの表面の面積は等しい。すなわち、表面部の矩形の短辺の長さをRとし、長辺の長さをSとすれば、面積はR×Sである。一方磁極歯群2B，2Eの表面の面積は等しく、この矩形の短辺の長さをQ

とし長辺をSとすれば面積はQ×Sである。ここで磁極歯群2A，2B，2Cと2D，2E，2Fの各面積の比率、すなわちR×S対Q×S対R×Sは1対2対1の比率に設定されている。

【0008】次に図2により本実施例の構成を説明する。図2に示すように、本実施例は永久磁石1、永久磁石1の両側に前述の磁極歯群2A，2B，2Cを有する磁石2（図右側）と、磁極歯群2D，2E，2Fを有する磁石2（図左側）とがあり、永久磁石1をはさみ込んでいる。また、駆動コイル3A，3Bがそれぞれ永久磁極歯群2A，2Cから挿入されて、所定の位置に巻き付けられる構造となる。駆動コイル3C，3Dも同様に磁極歯群2D，2Fから挿入されて所定の位置に巻き付けられる。

【0009】次に本実施例の動作を説明する。駆動コイル3A，3Bは、磁極歯群2Aと2Cを通る永久磁石1の磁束を強めるように励磁された時に磁極歯群2Bを通る永久磁石1の磁束を相殺するように接続されており、駆動コイル3C，3Dは磁極歯群2Dと2Fを通る永久磁石1の磁束を強めた時、磁極歯群2Eを通る永久磁石1の磁束を相殺するように接続されている。駆動コイルに電流を流すことにより、磁極歯群2A，2Cと磁極歯群2D，2Fの磁束を強めた時には、磁極歯群2A，2C，2D，2Fのそれぞれの中心が作る長方形の対角線の交点位置が吸引力の重心であり、磁極歯群2B，2Eの磁束を強めた時には、磁極歯群2B，2Eの中央が吸引力の重心となり、磁極歯群2A，2C，2E又は磁極歯群2D，2F，2Bの磁束を強めた時にも、常に磁極歯全体の吸引力は中心位置となる。したがって、可動子のピッチングとヨーイングの原因となる力がキャンセルされ、安定した動作を得ることができる。

【0010】次に本発明の第2の実施例を図3により、説明する。図3は第1の実施例の6個の磁極歯群を一体とした磁極歯板4と、鉄心22を有している。磁極歯板4は所定ピッチの磁極歯群をエッチングにて薄板上に形成し、永久磁石1をはさみ込んだ鉄心22上に取り付けたものであり、これらを図1のように樹脂で一体に成形する。電気的動作については、第1の実施例と同様である。

【0011】

【発明の効果】以上説明したように本発明は、励磁される磁極歯群の中間に別の磁極歯群を設け、その面積比を所定の比率に選ぶことにより、リニアパルスモータを駆動するために駆動コイルに流れる電流を反転させた時に、励磁された磁極歯群の位置の違いにより発生する可動子のピッチング及びヨーイングを無くし、常に安定した動作を確保できる効果を有する。

【図面の簡単な説明】

【図1】本発明の第1の実施例を示すリニアパルスモータの鉄心構造の外観を示す斜視図である。

【図2】本発明の第1の実施例の展開図である。

【図3】本発明の第2の実施例の展開図である。

【図4】従来のリニアパルスモータの鉄心構造の展開図である。

【図5】（a），（b）は、それぞれ従来例の組み立てらた状態の側面図、平面図である。

【符号の説明】

1　永久磁石

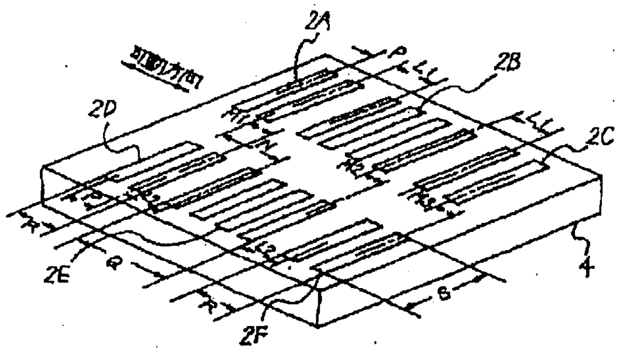
2　鉄心

2A～2F　磁極歯群

3A～3D　駆動コイル

4　成形樹脂

【図1】



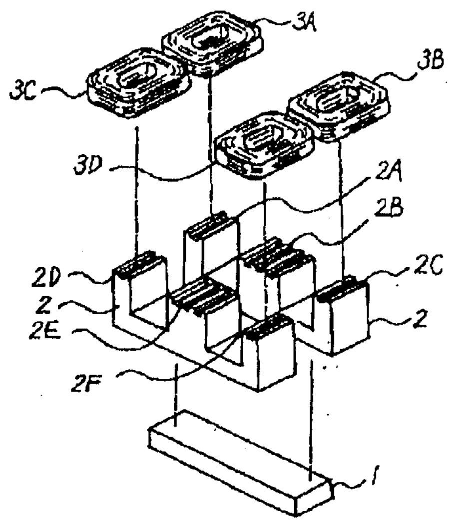
2A～2F：磁極歯群
4：成形樹脂

磁極歯群2A,2C,2D,2Fの各面積 R×S
磁極歯群2B,2Eの各面積 Q×S

$L1=L2=(n+1/2)P$
$M1=M2=M3=1/4P$
$N=(n+3/4)P$

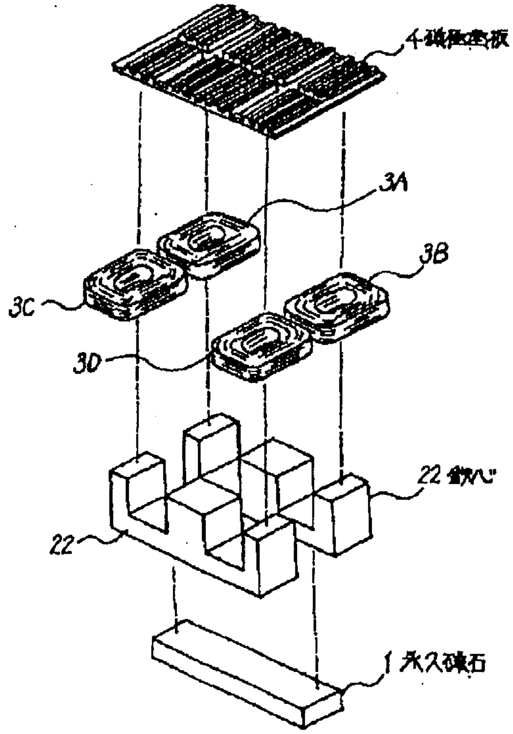
【図2】

1：永久磁石
2：鉄心
2A～2F：磁極歯群
3A～3D：駆動コイル



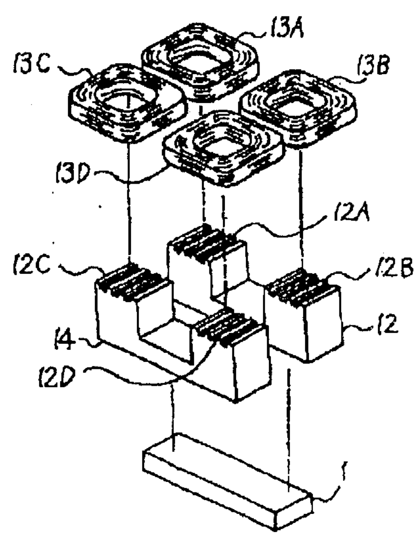
【図3】

3A～3D：駆動コイル

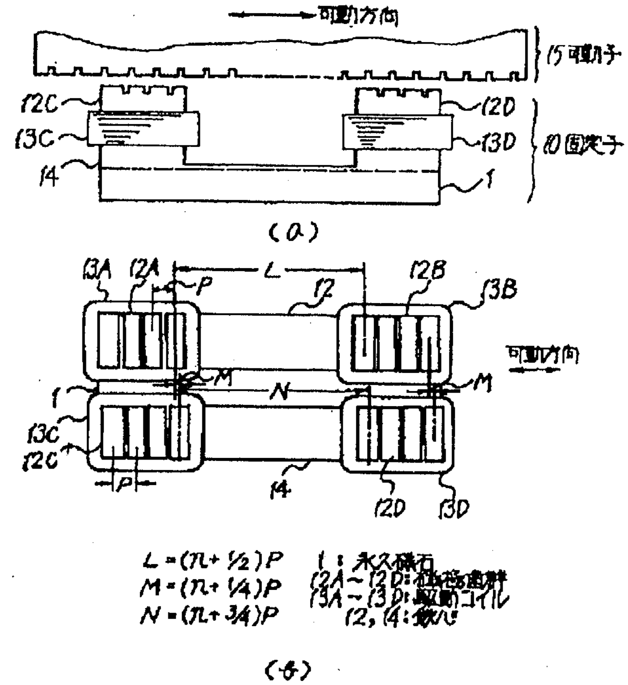


【図4】

1：永久磁石
12,14：鉄心
12A～12D：磁極歯群
13A～13D：駆動コイル



【図5】


可動方向
15 可動子
12C
12D
13C
13D
10 固定子
14
1
(a)
13A
12A
P
L
12
12B
13B
可動方向
M
N
M
1
13C
12C
P
14
12D
13D
L=(n+1/2)P
M=(n+1/4)P
N=(n+3/4)P
1：永久磁石
12A～12D：磁極歯群
13A～13D：駆動コイル
12, 14：鉄心
(b)

AF

09/926450

PTO 03-1093

Japanese Kokai Patent Application
No. Hei 4[1992]-210768

CORE STRUCTURE FOR LINEAR PULSE MOTOR

Yoshimori Tajima and Masami Nirei

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Examination Request:	Not filed

CORE STRUCTURE FOR LINEAR PULSE MOTOR

[Rinia parusu mota no teshhin kozo]

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Applicant:	000165033 Gunma Nippon Denki K.K.

[There are no amendments to this patent.]

Claims

1. A core structure for a linear pulse motor characterized in that in a core structure for a linear pulse motor having a permanent magnet, a first magnetic pole tooth group and a second magnetic pole tooth group provided at respective edge parts of 2 cores which sandwich the aforementioned permanent magnet, and driving coils wound around the respective poles of the aforementioned first magnetic pole tooth group and the second magnetic pole tooth group,

a third magnetic pole tooth group is provided between the aforementioned first magnetic pole tooth group and the second magnetic pole tooth group to create a convex part, and the ratio among the areas of respective tip parts of the aforementioned first magnetic pole tooth group, the

third magnetic pole tooth group, and the second magnetic pole tooth group is set roughly to 1:2:1.

2. The core structure for a linear pulse motor described under Claim 1 characterized in that a magnetic pole tooth plate created as one body with the aforementioned first, second, and third magnetic pole tooth groups by applying etching to a thin plate is placed tightly on the top surfaces of the 3 convex parts of the core having the aforementioned convex parts [sic. redundant], and they are created into one body using a resin.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a core structure for a linear pulse motor used for driving a head of a magnetic disk device. More specifically, it pertains to a core structure for a linear pulse motor with an improved primary core structure.

[0002]

Prior art

As for the core structure of a conventional core structure for a linear pulse motor, as shown in the unfolded diagram in Figure 4 and the side view and the plane diagram of its assembled condition in Figure 5 (a) and (b), magnetic pole tooth groups 12A, 12B, 12C, and 12D having areas of the same size are provided on cores 12 and 14 which are placed so as to sandwich permanent magnet 1, magnetic tooth group 12B is positioned at the distance of $L = (n + (1/2)) P$ (P is an integer) from magnetic pole tooth group 12A in terms of its distance in the direction it can move when the teeth pitch of the magnetic pole tooth group is denoted as P, magnetic pole tooth group 12C is away from magnetic pole tooth group 12A by $M = (n + (1/4)) P$, and magnetic pole tooth group 12D is similarly away from magnetic pole tooth group 12A by $M = (n + (3/4)) P$ in the direction it can move. Here, driving coils 13A and 13B for exiting magnetic pole tooth group 12A and 12B are connected in such a manner that the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 12A (or 12B) is intensified by the magnetic flux of driving coli 13A (or 13B), and the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 12B (or 12A) is offset by the magnetic flux of driving coil13B (or 13A). Similarly, driving coils 13C and 13D for exiting magnetic pole tooth group 12C and 12D are connected in such a manner that the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 12C is intensified by the magnetic flux of driving coil 13C, and the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 12D is offset by the magnetic flux of driving coli 13D. Alternatively, they are connected so as to perform

the opposite functions. That is, the magnetic pole tooth groups were arranged in such a manner that movable member 15 was able to be move by P/4 at a time by inverting the directions of currents applied to driving coils 13A and 13B and driving coils 13C and 13D of stator 10 in Figure 5 (a) alternately.

[0003]

Problem to be solved by the invention

In the case of said magnetic pole tooth group arrangement of the conventional linear pulse motor, because an absorbing force is acted upon magnetic pole tooth groups 12A and 12B when magnetic fluxes of magnetic pole tooth groups 12A and 12C are intensified, and an absorbing force is acted upon magnetic pole tooth groups 12B and 12D when magnetic fluxes of magnetic pole tooth groups 12B and 12D are intensified, pitching in the movable direction is generated of the moving member. In addition, because magnetic pole tooth groups with intensified magnetic fluxes are present diagonally when the magnetic fluxes of magnetic pole tooth groups 12A and 12D or magnetic pole tooth groups 12B and 12C are intensified, there is a problem that yawing in the movable direction was generated of the moving member.

[0004]

Therefore, there was also a problem that because the moving member moved by P/4 at a time while repeating pitching and yawing alternately, the stopping accuracy was deteriorated when it was to be used for head driving.

[0005]

Means to solve the problems

In the case of the core structure for a linear pulse motor of the present invention, in a core structure for a linear pulse motor having a permanent magnet, a first magnetic pole tooth group and a second magnetic pole tooth group provided at respective edge parts of 2 cores which sandwich the aforementioned permanent magnet, and driving coils wound around the respective poles of the aforementioned first magnetic pole tooth group and the second magnetic pole tooth group, a third magnetic pole tooth group is provided between the aforementioned first magnetic pole tooth group and the second magnetic pole tooth group to create a convex part, and the ratio among the areas of respective tip parts of the aforementioned first magnetic pole tooth group, the third magnetic pole tooth group, and the second magnetic pole tooth group is set roughly to 1:2:1.

[0006]

Application examples

Next, the present invention will be explained in reference to figures. Figure 1 is a slanted view showing an outer appearance of the product completed by fixing a primary core of an application example of the present invention using a molding resin. Figure 2 is an unfolded diagram showing the constituents of the first application example of the present invention except for the molding resin.

[0007]

In the application example in Figure 1, upper surfaces of magnetic pole tooth groups 2A, 2B, and 2C and magnetic pole tooth groups 2D, 2E, and 2F are exposed at the surface of molding resin 4 while arranged in parallel in the movable direction. Here, distance L1 between magnetic pole tooth groups 2A and 2B in the movable direction is equal to distance L1 between magnetic pole tooth groups 2B and 2C, and $L1 = (n + (1/2)) P$ (n is an integer), provided that P represents the pitch of an individual magnetic pole teeth. Similarly, distance L2 between magnetic pole tooth groups 2D and 2E is equal to distance L2 between magnetic pole tooth groups 2E and 2F, and $L2 = (n + (2)) P$. In addition, distance M1 between magnetic pole tooth groups 2A and 2D, distance M2 between 2B and 2E, and distance M3 between 2C and 2F in the movable direction are equal while they are shifted from one another by P/4. In addition, magnetic pole tooth groups 2A, 2D, 2C, and 2F have surface areas of the same size. That is, assuming that the length of the short side of the rectangular surface area is R, and the length of the long side, the area is R x S. On the other hand, magnetic pole tooth groups have surface areas of the same size, and the area is Q x S, provided that Q represents the length of the short side of said rectangle, and S represents the long side. Here, the ratio among the areas of magnetic pole tooth groups 2A, 2B, 2C, 2D, 2E, and 2F, that is, R x S:Q x S:R x S, is set to 1:2:1.

[0008]

Next, configuration of the present application example will be explained based on Figure 2. As shown in Figure 2, the present application example involves permanent magnet 1 along with magnet 2 (on the right in the figure) having aforementioned magnetic pole tooth groups 2A, 2B, and 2C on either side of permanent magnet 1 and magnet 2 (on the left in the figure) having aforementioned magnetic pole tooth groups 2D, 2E, and 2F which are placed to sandwich permanent magnet 1. In addition, driving coils 3A and 3B are inserted respectively from permanent magnetic pole tooth groups 2A and 2C and wound at prescribed positions. Similarly, driving coils 3C and 3D are inserted from magnetic pole tooth groups 2D and 2F and wound at prescribed positions.

[0009]

Next, operations of the present application example will be explained. Driving coils 3A and 3B are connected in such a manner that the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 2B is offset when excited so as to intensify the magnetic fluxes of permanent magnet 1 which goes through magnetic pole tooth groups 2A and 2C, and driving coils 3C and 3D are connected in such a manner that the magnetic flux of permanent magnet 1 which goes through magnetic pole tooth group 2E is offset when excited so as to intensify the magnetic fluxes of permanent magnet 1 which goes through magnetic pole tooth groups 2D and 2F. When the magnetic fluxes of magnetic pole tooth groups 2A and 2C and magnetic pole tooth groups 2D and 2F are intensified by applying currents to the driving coils, the intersection of the diagonal lines of the rectangle created by the respective centers of magnetic pole tooth groups 2A, 2C, 2D, and 2F constitutes the center of the gravity of the absorbing force; the center between magnetic pole tooth groups 2B and 2C constitutes the gravity of the absorbing force when the magnetic fluxes of magnetic pole tooth groups 2B and 2E are intensified; and the absorbing force of the entire magnetic pole tooth is at the center position also when the magnetic fluxes of magnetic pole tooth groups 2A, 2C, and 2E or magnetic pole tooth groups 2D, 2F, and 2B are intensified. Therefore, forces responsible for the pitching and the yawing of the movable member are offset, so that stale operations can be achieved.

[0010]

Next, a second application example of the present invention will be explained using Figure 3. Figure 3 involves magnetic tooth plate 4, for which the 6 magnetic pole tooth groups of the first application example are made into one body, and core 22. Magnetic tooth plate 4 has a configuration in which magnetic pole tooth groups are created at a prescribed pitch on a thin plate by means of etching and attached onto cores 22 which are placed to sandwich permanent magnet 1, and said [parts] are made into one body using a resin as shown in Figure 1. Its electrical operations are identical to those in the first application example.

[0011]

Effect of the invention

As explained above, because a third magnetic pole tooth group is provided between magnetic pole tooth groups to be excited, and a prescribed ratio is selected as the ratio of their surface areas in order to invert the currents applied to the driving coils to drive the linear pulse motor, the present invention offers an effect that the pitching and the yawing created due to the

difference in the positions of the magnetic pole tooth groups excited can be eliminated in order to assure stable operations.

Brief description of the figures

Figure 1 is a slanted view showing an outer appearance of the core structure for a linear pulse motor showing a first application example of the present invention.

Figure 2 is an unfolded diagram of the first application example of the present invention.

Figure 3 is an unfolded diagram of a second application example of the present invention.

Figure 4 is an unfolded diagram of the core structure for a conventional linear pulse motor.

Figure 5 (a) and (b) are a side view and a plane diagram showing the assembled condition of the conventional example.

Symbols

1	Permanent magnet
2	Core
2A-2F	Magnetic pole tooth group
3A-3D	Driving coil
4	Molding resin

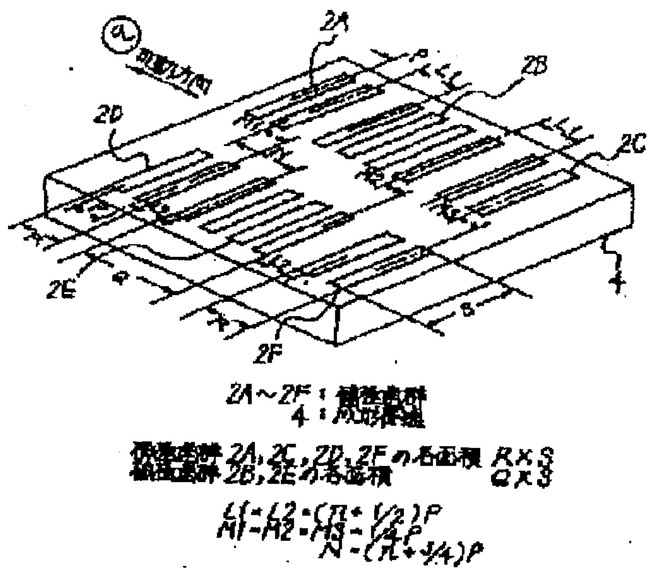

Figure 1

Key: a Movable direction
2A-2F Magnetic pole tooth group

4	Molding resin
R x S	Respective areas of magnetic pole tooth groups 2A, 2C, 2D, and 2F
Q x S	Respective areas of magnetic pole tooth groups 2B and 2E

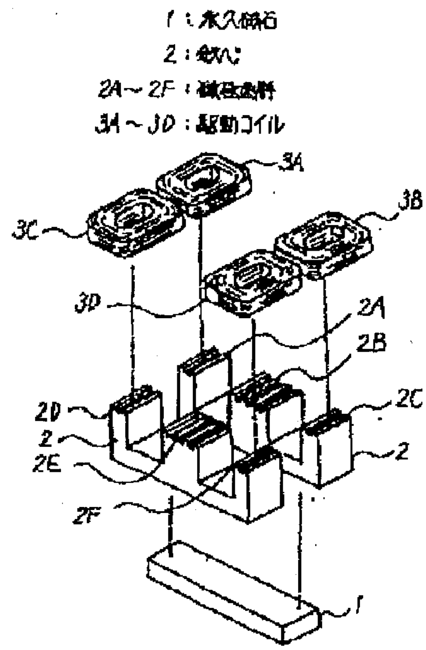

Figure 2

Key:

1	Permanent magnet
2	Core
2A-2F	Magnetic pole tooth group
3A-3D	Driving coil

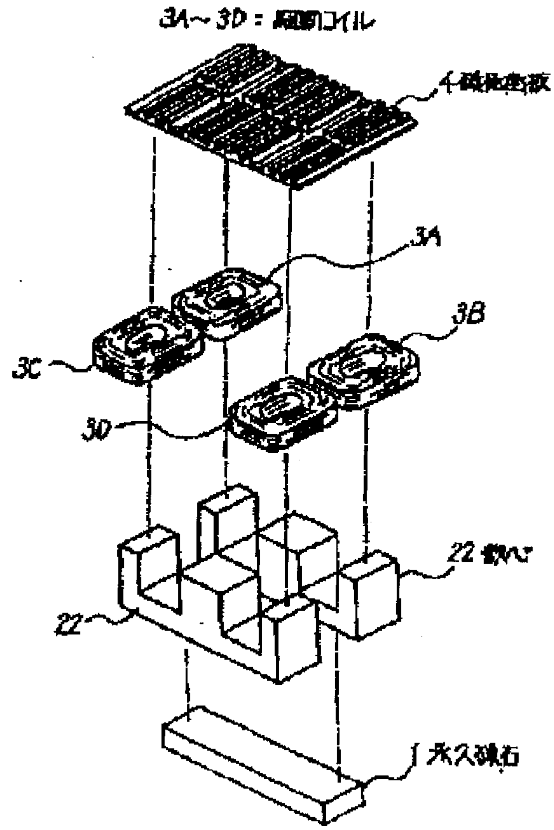

Figure 3

Key:
- 1 Permanent magnet
- 3A-3D Driving coil
- 4 Molding resin
- 22 Core

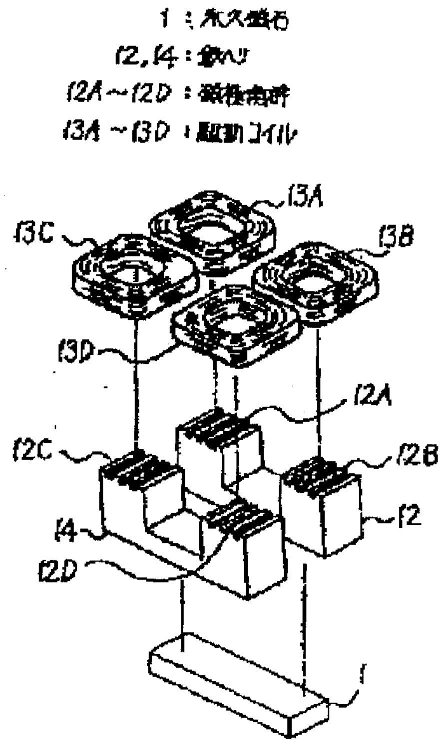

Figure 4

Key:	1	Permanent magnet
	12, 14	Core
	12A-12D	Magnetic pole tooth group
	13A-13D	Driving coil

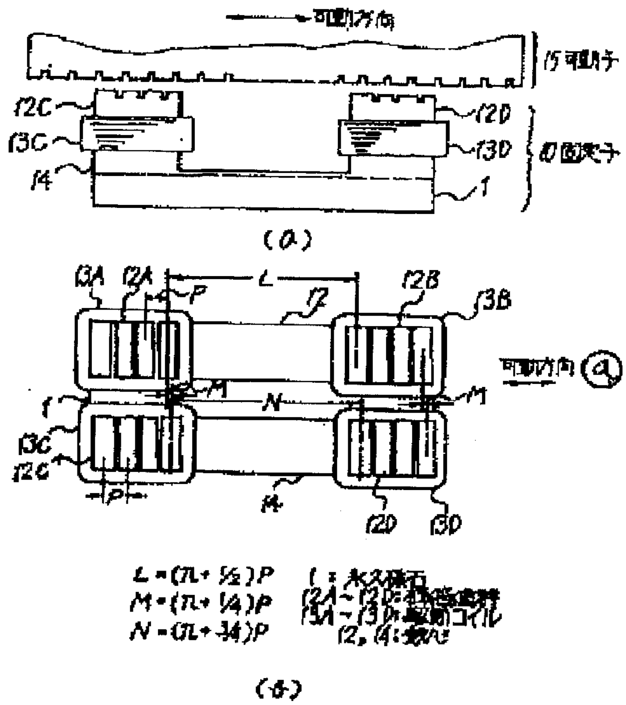

Figure 5 (a), (b)

Key:	a	Movable direction
	1	Permanent magnet
	10	Stator
	12, 14	Core
	12A-12D	Magnetic pole tooth group
	13A-13D	Driving coil